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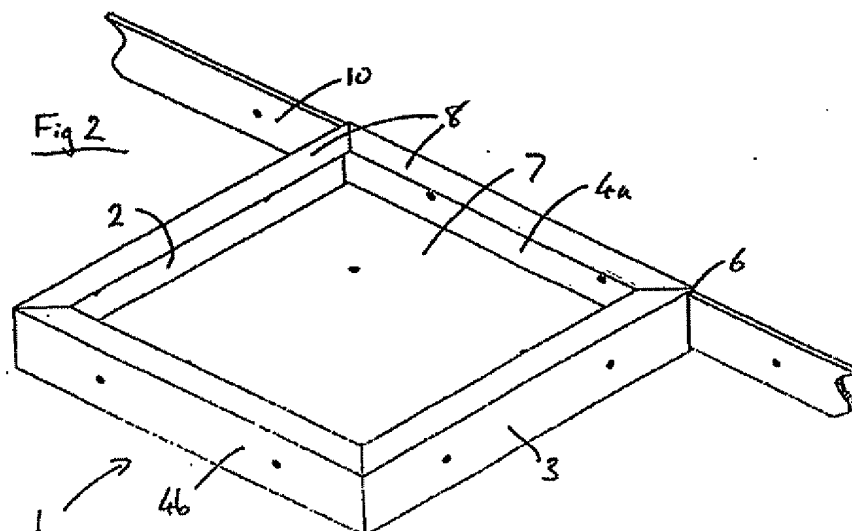
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(54) Abstract Title

A modular building structure comprising frame and reinforcement

(57) A modular building structure comprises at least one unit (1) comprising a frame having three or more interconnected side portions (2, 3, 4a, 4b) wherein at least one of the said side portions (2, 3, 4a, 4b) is provided with at least one means (6) to receive a strengthening-member (10). In a first embodiment the strengthening-member (10) is a continuous bar which is positioned substantially parallel to one of the side portions (4a) and passing through a conduit formed integrally with one side portion (4a) at the frame. In a second embodiment (not shown) the strengthening-member is a tongue held in place relative to the unit of construction by a pin passing through an aperture provided in the tongue.



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Fig 1

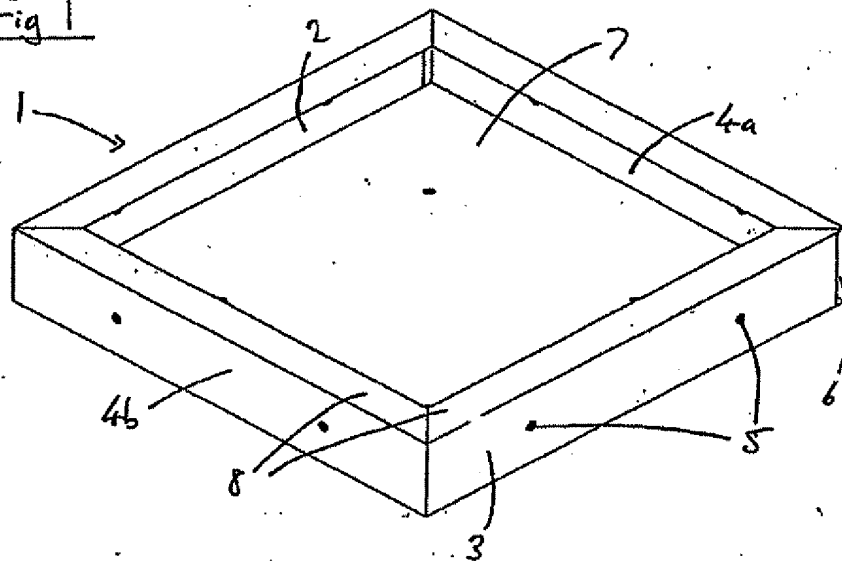
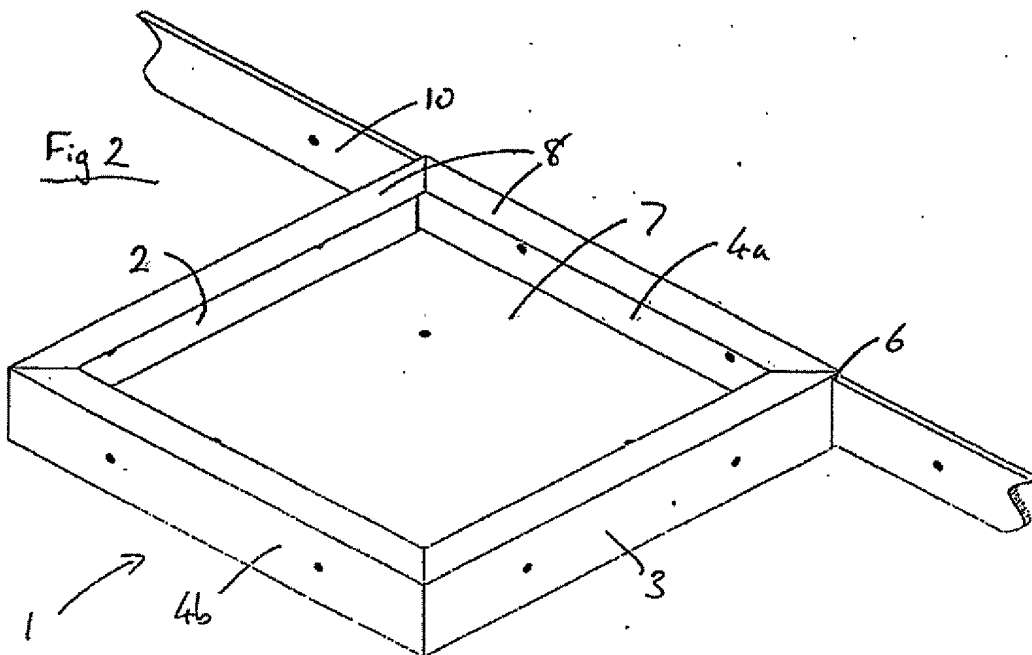


Fig 2



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Fig 3

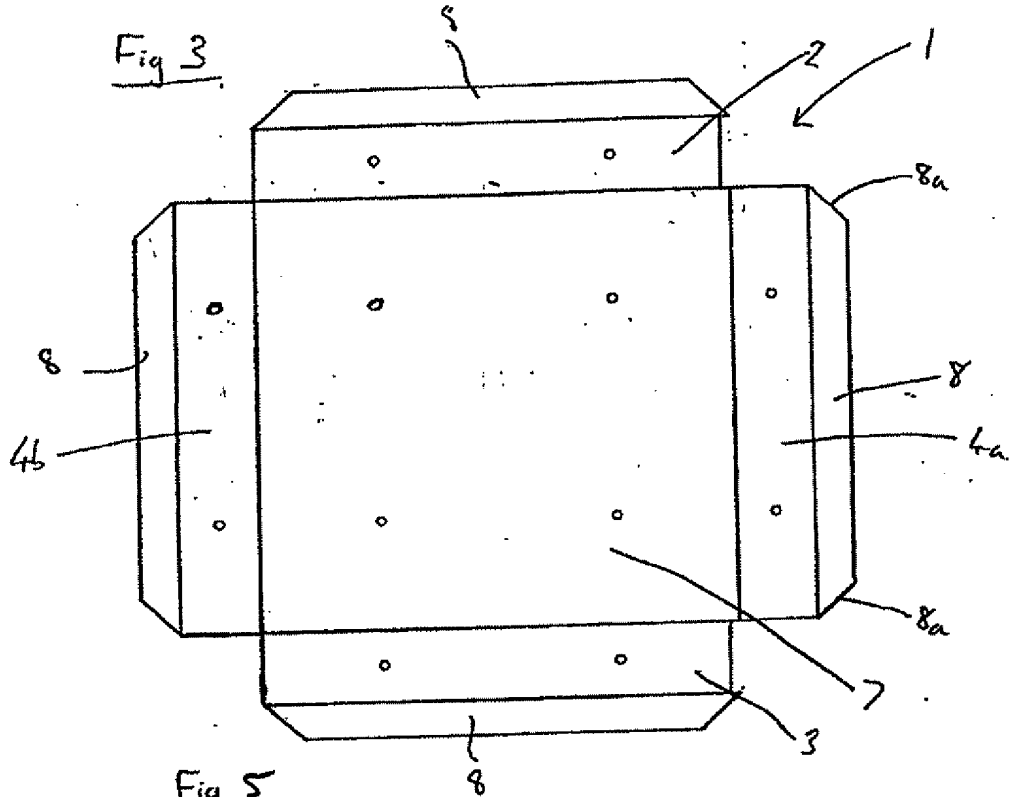
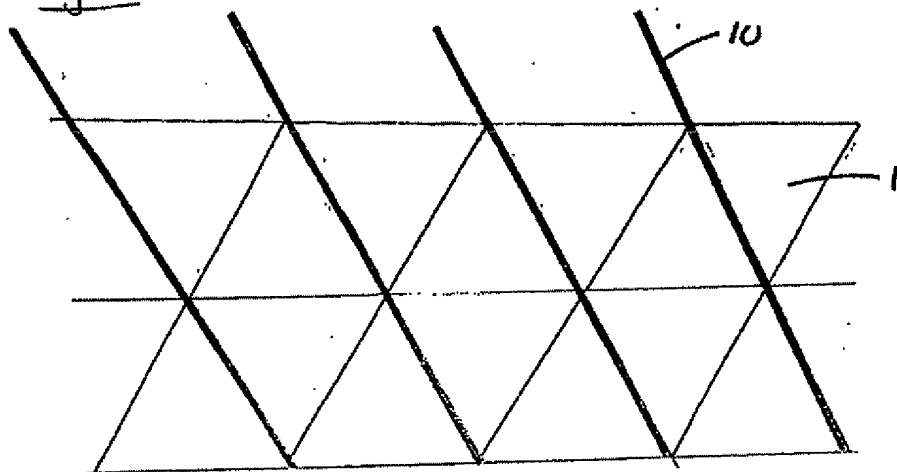
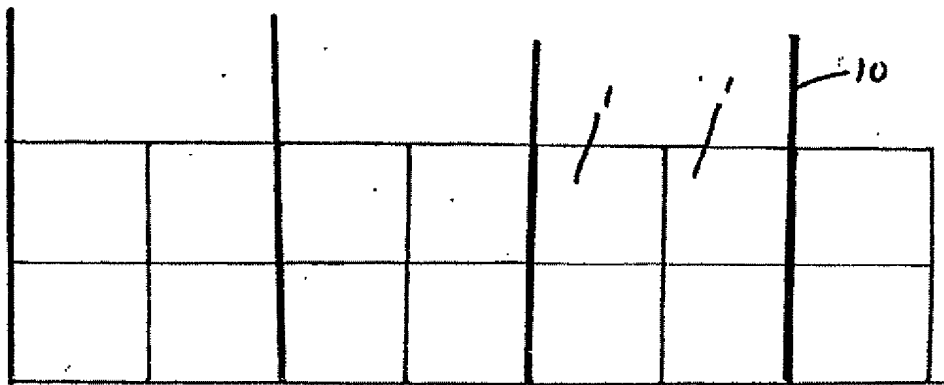
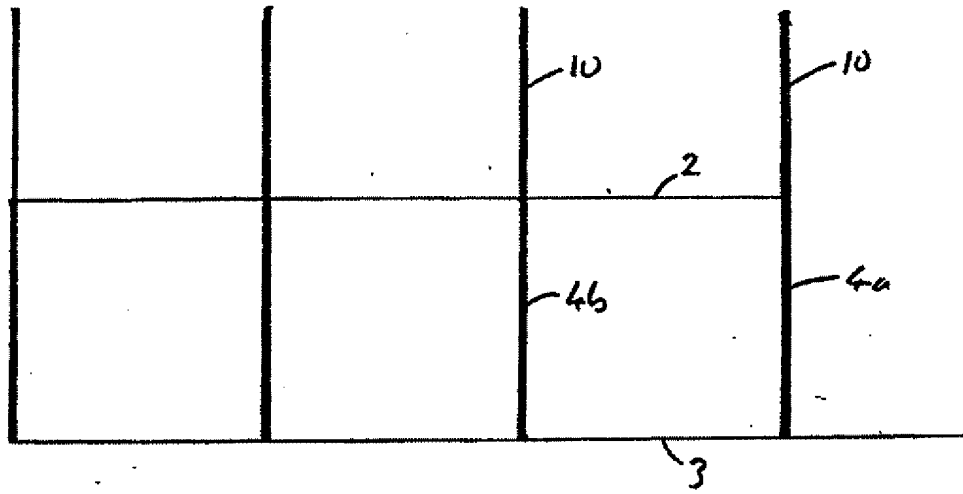


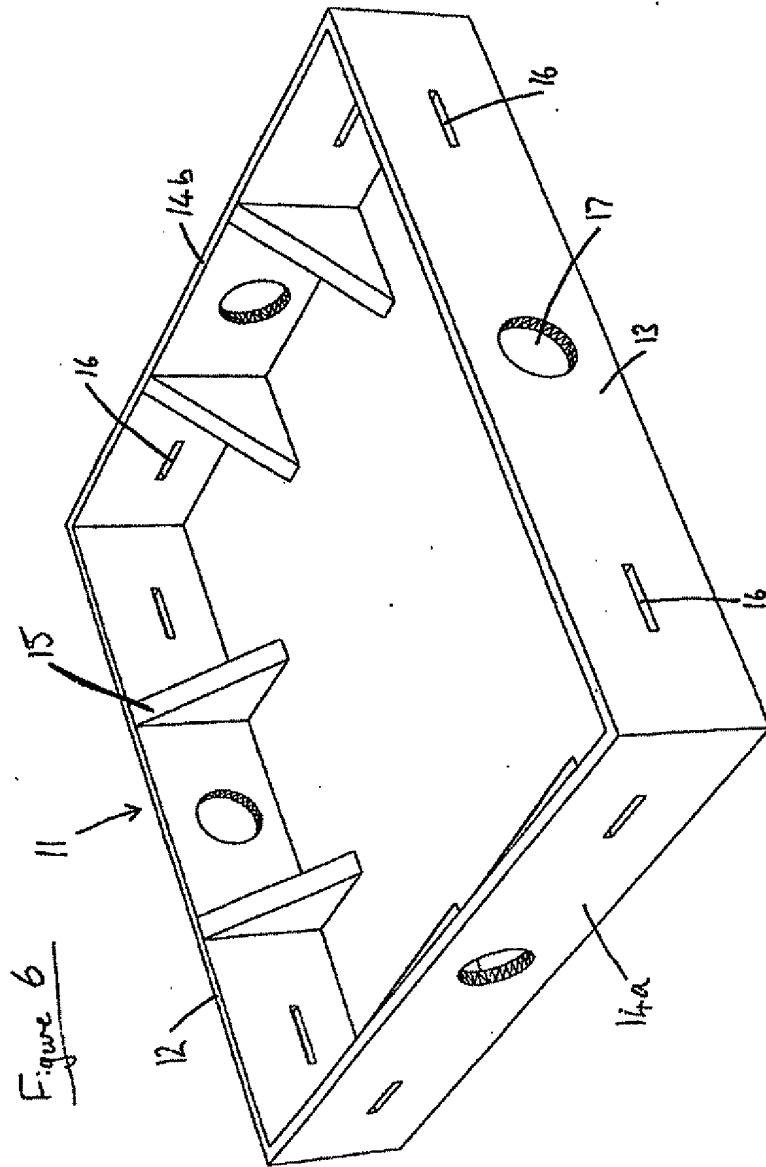
Fig 5



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Fig 4





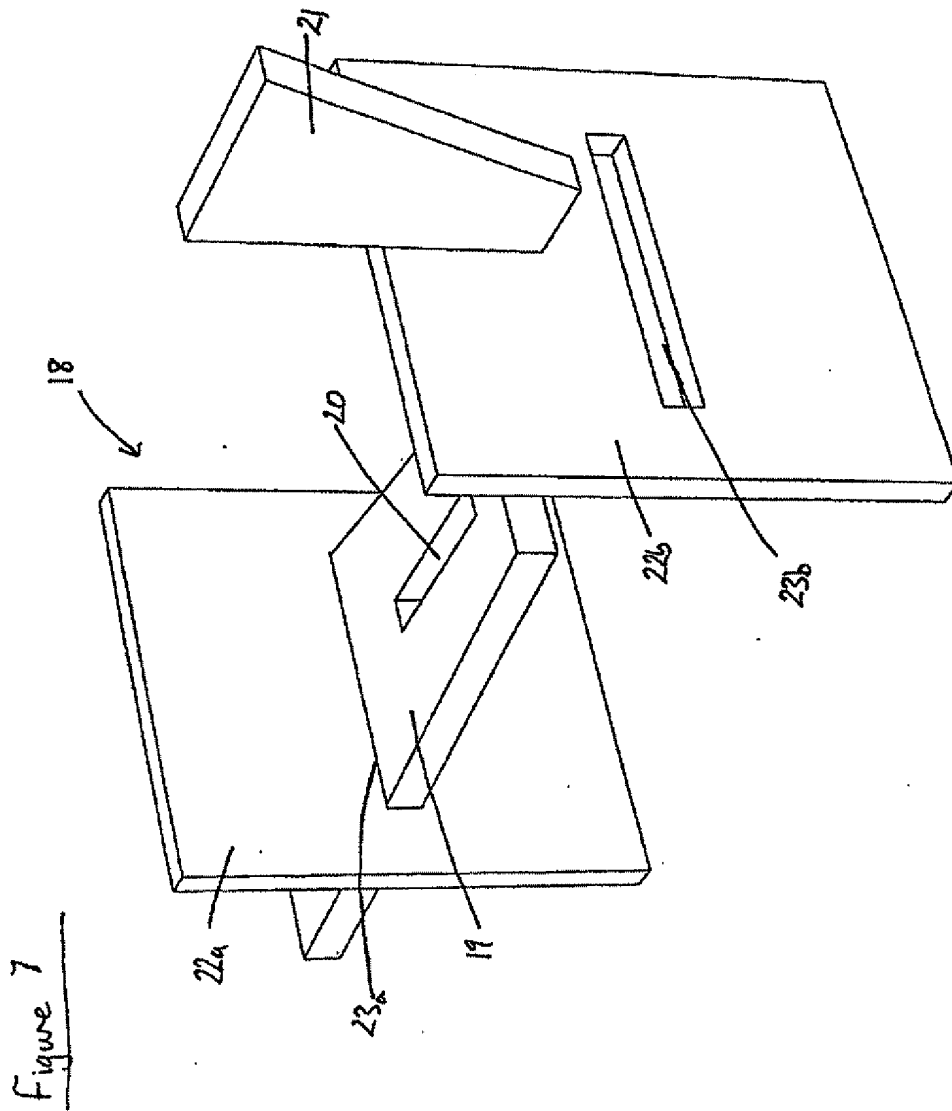
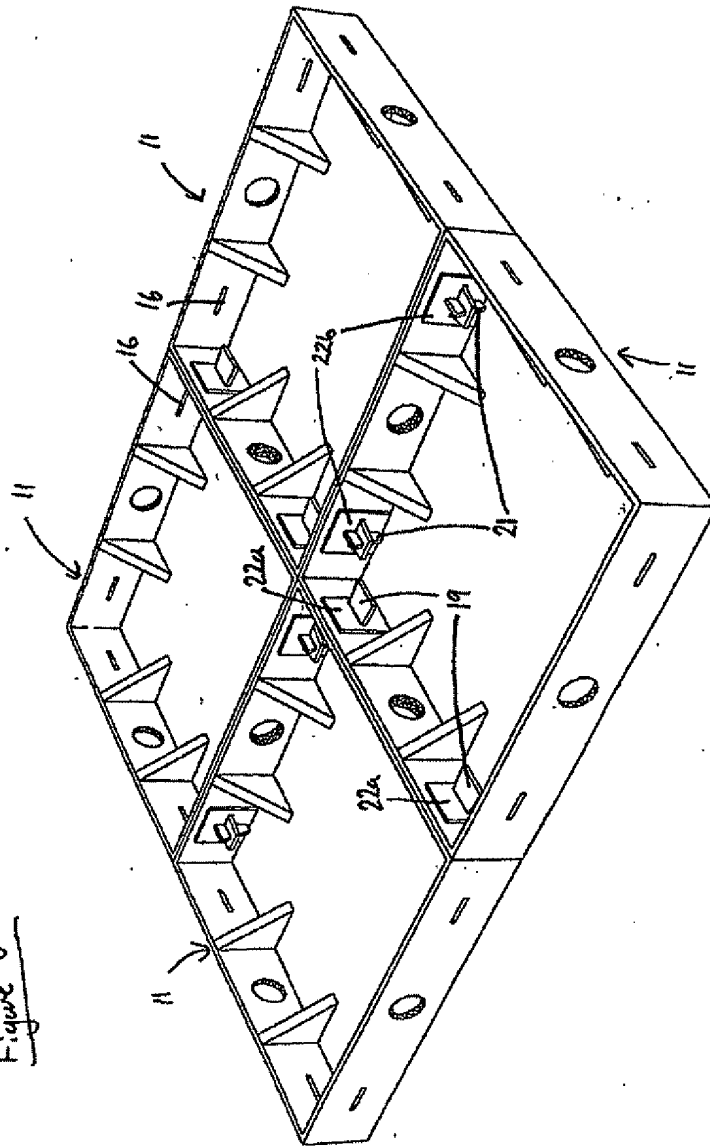


Figure 8



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MODULAR BUILDING STRUCTURES

The present invention relates to improvements in modular building structures which are built up from a number of co-operating units.

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It is known to construct tanks from co-operating metal panels which are bolted together at their adjacent edges. It is also known to build structures from interengaging panels of precast concrete or of refractory materials.

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However, these materials are generally not suitable when building structures of substantial height as they are not of sufficient strength and rigidity to be self-supporting. Therefore, a separate support-structure is generally required.

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An attempt was made to overcome this problem by providing a unit for construction of a modular structure comprising a frame having permanently secured thereto at least two vertical metal support members, such as tubes, extending between top and bottom members of the frame.

20 The tubes have spigots extending outwardly, at one end for engagement with the tubes of an adjacent unit, so that the mutually-engaging tubes form continuous load-bearing columns.

25

There are, however, problems associated with such known systems as the two-dimensional pitch of the structure cannot be maintained over a large area. This is because the spigots only enter a little way into the tubes of an adjacent unit and therefore some flexing can occur, causing a change in the two dimensional pitch of the structure.

Furthermore, such known systems can interfere with structural steelwork of a building (and vice versa) and the tubes are moreover costly to manufacture.

- 5 The object of the present invention is to provide a modular building structure built up from a number of co-operating units which can maintain the required two-dimensional pitch, which does not interfere with any existing structural steelwork and which is relatively cheap to manufacture.
- 10 Accordingly, the present invention provides a unit suitable for construction of a modular building structure, the unit comprising a frame having three or more interconnected side portions, wherein at least one of the said side portions is provided with at least one means to receive a strengthening-member.
- 15 Preferably at least one face of the frame supports cladding to provide an infilled building structure.
- 20 Preferably the frame has a top portion, a bottom portion and two side portions. For example, it may be square or rectangular. The frame may alternatively be triangular.
- 25 The present invention also provides a modular building structure comprising at least one unit as described above together with at least one strengthening-member adapted to be received by two or more of said units when said units are assembled adjacent one another.
- 30 The strengthening-member, as well as acting to strengthen the building structure, joins the units together.

In a first preferred embodiment of the present invention, the or each strengthening-member is, in use, positioned substantially parallel to and substantially contiguous with one of said side portions.

5 The unit is preferably made out of a metal.

The or each strengthening member can be part of the structural steelwork of a building, which means that the modular building structure can be integral with the structural steelwork rather than interfering with it.

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The or each strengthening member preferably passes along the whole length of one side portion of at least one construction unit, thereby limiting the flexing of the unit and maintaining the two-dimensional pitch of the modular structure.

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Preferably one or more of the side portions of the or each unit are provided with bolt holes so that two or more units can be bolted one to another when in position. The or each strengthening member may have bolt holes corresponding to those of the units so that adjacent units can be

20 bolted to each other and to the strengthening member.

The receiving means preferably comprises slots provided near the ends of the sides of the frame adjacent the side of the frame along which the strengthening member is to be positioned. In this case the strengthening member will pass along the inside face of the respective side portion and will be received by the slots in the ends of adjacent side portions. Slots may be provided at one end of each of the two opposite side portions, at both ends of each of the two opposite side portions or at both ends of all four side portions to provide receiving means for one or two strengthening

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30 members and to allow the unit to be used in any orientation.

The means for receiving the strengthening member may comprise at least one conduit formed integrally with at least one side portion of the frame. The conduit may extend along all or part of the length of the side portion.

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Alternatively, the conduits may be welded onto the outer surface of at least one of the side portions. Again, the conduits may extend along all or part of the length of the side portions, for example they may be in the form of U-shaped guides of minimal width or they may be in the form of

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flattened tubes extending along the whole length of the side portion.

The or each strengthening-member preferably comprises a continuous bar (which may suitably be made of a metal).

- 15 Preferably the continuous bar is of generally flat cross-section. Alternatively, it may be of square or circular cross-section.

A generally flat continuous bar is easy and cheap to make and readily handled.

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The first preferred embodiment of the present invention also provides a method of constructing a modular building structure, said method comprising passing a strengthening member through the receiving means of a number of adjacent units of construction (as hereinbefore described)

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to form a two-dimensional modular structure.

The strengthening member may be passed through the receiving means of a number of units of construction when the units are positioned adjacent to one another.

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Alternatively, the units of construction may be threaded on to the strengthening member one at a time.

5 In a second preferred embodiment of the present invention, the or each strengthening-member preferably comprises a tongue adapted to be received by said means adapted to receive a strengthening-member, together with one or more means to secure the tongue relative to the unit of construction. Preferably, such means may comprise a pin adapted to pass through an aperture provided in the tongue.

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In accordance with the second preferred embodiment of the present invention, the unit may be made of metal. However, more preferably the unit is made of reinforced moulded cardboard. The reinforced moulded cardboard unit is preferably provided with a waterproof coating. The reinforced moulded cardboard units may be provided with one or more buttresses to add further strength and stability.

15

The use of reinforced moulded cardboard makes the units light and easy to handle and useful, especially in domestic housing applications.

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The strengthening-member may additionally comprise one or more strengthening panels, having apertures through which the tongue portion can pass, to be positioned on one or both sides of the units to be joined together. Strengthening panels may also be positioned between the units being joined together.

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The strengthening means of the second embodiment may be made from reinforced moulded cardboard.

The receiving means preferably comprise slots provided in the side portions, each slot being of a suitable size to receive a tongue. The receiving means of one unit align with that of another unit when the units are placed adjacent each other.

5

The second embodiment of the present invention also provides a method of constructing a modular building structure, said method comprising passing a tongue through the receiving means of two adjacent units of construction (as herein before described) and securing the tongue relative
10 to the units to form a two dimensional modular structure.

The present invention will now be illustrated, merely by way of example, in the following description and with reference to the accompanying drawings, in which:-

15

Figure 1 shows a perspective view of a unit of construction according to the first embodiment of the present invention;

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Figure 2 shows a perspective view of the unit of Figure 1 co-operating with a continuous bar to give a modular building system according to the first embodiment of the present invention;

Figure 3 shows the layout view of the unit of Figure 1;

25

Figure 4 shows two modular structures comprising the unit of Figure 1;

30

Figure 5 shows a modular structure according to the first embodiment of the present invention and comprising triangular units;

Figure 6 shows a perspective view of a unit of construction according to the second embodiment of the present invention;

5 Figure 7 shows an expanded view of the strengthening means of the second embodiment of the present invention; and

Figure 8 shows a modular structure comprising the strengthening means of Figure 7 and the units of Figure 6.

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The unit of construction 1 shown in Figure 1 comprises a frame having a top portion 2, a bottom portion 3 and two side portions 4a, 4b (which may be formed from stainless steel to remove the need to paint or to treat the frame for corrosion). The frame is generally square and bolt holes 5 are provided in each of the top, bottom and side portions to allow adjacent identical units to be secured one to another when positioned in a modular building structure. The unit 1 has cladding 7 secured to one of its faces. The cladding 7 may also be provided with bolt holes 5.

20 The top portion 2 and bottom portion 3 of the frame are each provided with slots extending across their width. The slots 6 are adjacent the side 4a.

Figure 3 shows the unit 1 prior to its assembly. The slots 6 are formed when the layout of Figure 3 is assembled such that the top portion 2, bottom portion 3 and side portions 4a, 4b are at right angles to the plane of the cladding 7 and the trapezoidal flaps 8 are folded inwardly so that they lie at an acute angle to the planes of the top portion 2, bottom portion 3 and side portions 4a, 4b and meet at their inclined ends 8a. The length of the top portion 2 and bottom portion 3 can be seen to be shorter

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than the length of the corresponding edge of the cladding, so that when they are folded into position a slot 6 is defined between the ends of the top portion 2 and bottom portion 3 and the side portion 4a.

- 5 The unit may be made with the top portion 2 and bottom portion 3 being shorter in length at each end than the corresponding edge of the cladding 7, to define slots 6 adjacent sides 4a and 4b. Alternatively, the sides 4a and 4b may be shortened at one or both ends to define slots 6 adjacent the top or bottom portions. It is also envisaged that top
- 10 portion 2, bottom portion 3 and side portions 4a and 4b could all be shortened at both ends to define slots 6 adjacent all 4 sides.

Figure 2 shows a continuous flat metal bar 10 (which is preferably also made of stainless steel) received by the slots 6 to create part of a modular

- 15 building structure. As this continuous bar passes along the whole length of the side 4a it imparts increased strength and stiffening to the unit 1.

In use, the units 1 are assembled adjacent to each other to form a modular building structure which is strengthened and stiffened by a number of

- 20 continuous bars 10 passing through the slots 6 of adjacent units 1. The bars 10 may be positioned so that there is one bar passing between each vertical or horizontal row of units 1 or there may be one bar for every two vertical or horizontal rows. Other configurations can be envisaged and examples are shown in Figure 4. The invention may also be suitable
- 25 for other shaped (e.g. triangular) frames, as shown in Figure 5.

The unit of construction 11 shown in Figure 6 comprises a frame having a top portion 12, a bottom portion 13 and two side portions 14a, 14b (which may be formed from reinforced moulded cardboard). The frame is

generally square and has buttresses 15 secured thereto to add strength and stability to the unit.

5 The top, bottom and side portions of the frame are each provided with two horizontal slots 16, one near each end of the top, bottom and side portions.

Each unit is provided with cut-out circles 17 for trunking or pipes to be passed through the structure to carry, for example, electricity cables and
10 water or gas pipes.

Figure 7 shows the strengthening means 18 for use with the unit of Figure 6. The strengthening means 18 comprises a tongue 19 adapted to be received by one of the slots 16 in the unit 11. The tongue has a slot 20
15 extending along part of its longitudinal centre line. A wedge 21 engages, in use, the slot 20 to secure the tongue 19 relative to the unit. The strengthening device is further provided with strengthening panels 22a, 22b, each panel having a slot 23a, 23b adapted to receive the tongue 19.

20 In use the units 11 are assembled adjacent each other to form a modular building structure as shown in Figure 8. The tongue 19 of the strengthening-member passes through the slot 23a of strengthening panel 22a, through horizontal slot 16 of unit 11 and through slot 23b of strengthening panel 22b. The tongue 19 and strengthening panels 22a,
25 22b are held in place by means of a wedge 21 passing through slot 20 in tongue 19.

CLAIMS

1. A unit suitable for construction of a modular building structure, the unit comprising a frame having three or more interconnected side portions, wherein at least one of the said side portions is provided with at least one means to receive a strengthening-member.
2. A construction unit according to claim 1 wherein at least one face of the frame supports cladding to provide an infilled building structure.
3. A modular building structure comprising at least one unit according to claim 1 or claim 2 together with at least one strengthening-member adapted to be received by two or more of said units when said units are assembled adjacent one another.
4. A modular building structure according to claim 3 wherein the or each strengthening-member is, in use, positioned substantially parallel to and substantially contiguous with one of said side portions.
5. A modular building structure according to claim 3 or claim 4 wherein the strengthening-member constitutes, in use, part of the structural steelwork of a building.
6. A modular structure according to claim 5 wherein the or each strengthening-member passes along the whole length of one side portion of at least one construction unit, thereby limiting the flexing of the unit and maintaining the two-dimensional pitch of the modular structure.

7. A modular structure according to any one of claims 3-6 wherein one or more of the side portions of the or each unit are provided with bolt holes so that two or more units can be bolted one to another when in position.

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8. A modular structure according to claim 7 wherein the or each strengthening-member has bolt holes corresponding to those of the or each unit so that adjacent units can be bolted to each other and to the or each strengthening-member.

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9. A modular structure according to any one of claims 3-8 wherein the receiving means of the or each unit comprise slots provided near ends of the side portions of the unit adjacent the side portion of the unit along which the or each strengthening-member is to be positioned.

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10. A modular structure according to claim 9 wherein slots are provided at one end of each of two opposite side portions, at both ends of each of two opposite side portions or at both ends of all side portions of the or each unit to provide receiving means for one or two strengthening-
20 members and to allow the unit to be used in any orientation.

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11. A modular structure according to any one of claims 3-8 wherein the means for receiving the strengthening-member comprises at least one conduit formed integrally with at least one side portion of the or each unit.

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12. A modular structure according to any one of claims 3-8 wherein the means for receiving the strengthening-member comprises at least one conduit welded onto the outer surface of at least one of the side portions of the or each unit.

13. A modular structure according to claim 11 or claim 12 wherein the or each conduit extends along all or part of the length of the or each side portion.
- 5 14. A modular structure according to any one of claims 11-13 wherein the or each conduit is in the form of a U-shaped guide of minimal width or in the form of a flattened tube extending along the whole length of the or each side portion.
- 10 15. A modular structure according to any one of claims 3-14 wherein the or each strengthening-member comprises a continuous bar.
- 15 16. A method of constructing a modular building structure, said method comprising passing at least one strengthening-member through the receiving means of a number of adjacent units of construction according to claim 1 to form a two-dimensional modular structure.
- 20 17. A method according to claim 16 wherein the or each strengthening-member is passed through the receiving means of a number of units of construction when the units are positioned adjacent to one another.
18. A method according to claim 16 wherein the units of construction are threaded on to the or each strengthening-member one at a time.
- 25 19. A method according to any one of claims 16-18 wherein the or each strengthening-member comprises a continuous bar.
20. A modular structure according to claim 3 wherein the or each strengthening-member comprises a tongue adapted to be received by said

means adapted to receive a strengthening-member, together with one or more means to secure the tongue relative to the unit of construction.

21. A modular structure according to claim 20 wherein the means to
5 secure the tongue comprises a pin adapted to pass through an aperture provided in the tongue.

22. A modular structure according to claim 20 or claim 21 wherein the
or each strengthening-member additionally comprises one or more
10 strengthening panels having apertures through which the tongue can pass, to be positioned on one or both sides of the units to be joined together.

23. A modular structure according to any one of claims 20-22 wherein
the receiving means comprise slots provided in the side portions of the
15 units of construction, each slot being of a suitable size to receive a tongue.

24. A method of constructing a modular building structure, said method
comprising passing a tongue through the receiving means of two adjacent
20 units of construction according to claim 1 and securing the tongue relative to the units to form a two dimensional modular structure.

25. A unit suitable for construction of a building structure substantially
as described herein with reference to figures 1 and 3 of the accompanying
25 drawings.

26. A modular building structure substantially as described herein with
reference to figures 2 and 5 to 8 of the accompanying drawings

27. A method of constructing a modular building structure substantially as described herein.



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INVESTOR IN PEOPLE

Application No: GB 9914443.8
Claims searched: 1-27

Examiner: Peter Mason
Date of search: 4 November 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK CI (Ed.Q): E1D: DLEQWNV, DLEQWNW, DLEQWSV, DLEQWSW, DLEKN,
DLEF, DK, DLCQW, DLCF, DLCKN
Int CI (Ed.6): E04B
Other: -

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X,P	GB2321474 WALLTEC	1,2,3,4,15
X	GB2147028 DEGUT	1,2,3,4,15
X	GB1375790 BARTELS	1,2,9,10,15
X	GB1373954 DIXON	I
X	US5555698 MANDISH	1,2,4-6,11,13,15
X	WO96/23945 HADDOCK	1,2,3,15-17,19

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